

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of:

Tomomi YAMANOBE

Appl. No.: 09/893,487
Confirmation No.: 6307

Filed: June 29, 2001

For: WIRING LAYER STRUCTURE
FOR FERROELECTRIC
CAPACITOR

Art Unit: 2822

Examiner: Monica Lewis

Atty. Docket No.: 32011-173478

Customer No. 26694

BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an appeal from the final Office Action dated January 28, 2004. This Brief is submitted in triplicate.

I. Real Party in Interest

The real party in interest is Oki Electric Industry Co., Ltd. of 7-12, Toranomom 1-chome, Minato-ku, Tokyo, Japan, by virtue of an Assignment recorded June 21, 2001 at Reel 0011956, Frame 0615.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of Claims

Claims 1-5 and 7-15 stand finally rejected. The final rejections of claims 1-5 and 7-15 are appealed.

IV. Status of Amendments

In response to the Final Office Action of January 28, 2004, Applicant filed an After Final Request for Reconsideration on April 28, 2004. On May 19, 2004, an Advisory Action was mailed. Accordingly, no amendments subsequent to the final rejection are pending.

V. Summary of the Invention

The present invention relates to a wiring layer structure for a ferroelectric capacitor.

Ferroelectric storage that uses ferroelectric material as the material for the capacitor is reaching a stage for practical use as a type of non-volatile device. Memory devices equipped with ferroelectric capacitors require low voltage, have low power consumption, and operate at high speeds because of the characteristics of this ferroelectric material.

A problem that existed prior to this invention is the degradation of the characteristics of thin ferroelectric films by hydrogen. Many ferroelectric materials in memory oxides consist of a multiplicity of elements. Typical such metal oxide materials include $\text{SrBi}_2\text{Ta}_2\text{O}_9$ (SBT), and

Pb(Zr, Ti) O₃. After formation of the ferroelectric capacitor configuration using these materials, if activated hydrogen (hydrogen radicals: H^{*}) or molecular hydrogen (H₂) is activated during the processes that complete a semiconductor device, these hydrogen radicals reduce the oxygen in the ferroelectric material and therefore the oxygen in the thin ferroelectric film. This reduction causes degradation of the characteristics of the ferroelectric material in the thin ferroelectric film.

The present invention provides a means of preventing the degradation of the characteristics of a thin ferroelectric film caused by the formation of contact wiring. For example, referring to Figure 1, in an exemplary embodiment of the invention, a wiring layer structure connected to a first electrode of a ferroelectric capacitor has first and second electrodes. The wiring layer structure includes a main wiring layer 30 that includes a first material and a coating layer 60. The coating layer 60 includes a first coating part 20 provided between the main wiring layer and the first electrode, a second coating part 50 provided on the top surface of the main wiring layer, and a third coating part 40 covering side faces of the main wiring layer. The first material reacts with a substance to produce a reducing agent. The substance is infiltrated from the outside to the main wiring layer, and the coating layer is conductive and includes a second material for preventing the infiltration of the substance into the main wiring layer 30.

VI. Issues

The issues are:

1. Whether the Examiner erred in rejecting claims 1-5 and 7-14 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,165,802 to Cuchiaro et al. ("the Cuchiaro patent") in view of U.S. Patent No. 6,174,766 to Hayashi et al. ("the Hayashi patent").

2. Whether the Examiner erred in rejecting claim 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,165,802 to Cuchiaro et al. ("the Cuchiaro patent") in view of U.S. Patent No. 6,174,766 to Hayashi et al. ("the Hayashi patent") and U.S. Patent No. 6,249,014 to Bailey ("the Bailey patent").

VII. Grouping of Claims

The claims are grouped into four groups as follows:

Issue 1:

A. Claims 1-5 and 7-14 stand or fall together.

Issue 2:

A. Claim 15 stands or falls alone.

VIII. Argument

Each of the two groups listed in the previous section are discussed in turn.

VIII.1 Claims 1-5 and 7-14.

VIII.1.A Claims 1-5 and 7-14 are patentable over the combination of the Cuchiario patent and the Hayashi patent.

Independent claim 1 recites a wiring layer structure comprising a main wiring layer and a coating layer. The coating layer comprises a first coating part, a second coating part and a third coating part *covering* the side faces of the main wiring layer. Referring to Figure 1, for example, a wiring layer structure connected to a first electrode of a ferroelectric capacitor has first and second electrodes. The wiring layer structure includes a main wiring layer 30 that includes a first material and a coating layer 60. The coating layer 60 includes a first coating part 20 provided between the main wiring layer and the first electrode, a second coating part 50 provided on the top surface of the main wiring layer, and a third coating part 40 covering side faces of the main wiring layer. The first material reacts with a substance to produce a reducing agent. The substance is infiltrated from the outside to the main wiring layer, and the coating layer is conductive and includes a second material for preventing the infiltration of the substance into the main wiring layer 30.

In asserting this ground of rejection, the Office Action asserts that Cuchiario teaches a main wiring layer 134 including a first material and a coating layer including a first coating part 126 provided between the main wiring layer and a first electrode 124. The Office Action further asserts that the coating layer (as taught by the Cuchiario patent) is conductive and comprises a second material for preventing the infiltration of a substance into the main wiring layer. See, the Cuchiario patent, col. 5, lines 14-32. The Office Action acknowledges that the Cuchiario patent fails to teach or suggest a second coating part (of the coating layer) provided on the top surface of

the main wiring layer and a third coating part (of the coating layer) provided on the side faces of the main wiring layer.

To overcome these deficiencies, the Office Action, referring to Figure 13, asserts that the Hayashi patent teaches a coating part on the sides of the wiring layer and that it would have been obvious to one having ordinary skill in the art to modify the semiconductor device of the Cuchiaro patent to include a coating layer on the sides of the wiring layer because doing so aids in providing a reliable connection without deterioration. Applicants respectfully traverse this rejection.

Independent claim 1 recites, in pertinent part, the third coating part covering side faces of said main wiring layer. The plain and ordinary meaning of the claim term "covering" means to place something upon or over, so as to protect or conceal, see the American Heritage Dictionary of the English Language, 4th Edition, Houghton Mifflin Company, 2000. Consequently, claim 1 requires that the third coating part is placed upon or over the main wiring layer so as to protect or conceal the main wiring layer.

The three distinct coating parts recited in claim 1 advantageously prevent any reaction between substances, i.e., water or molecular hydrogen, on the surface of the main wiring layer. Because no reducing agent is provided in the main wiring layer, Applicant's invention more effectively prevents a degradation of the characteristics of a ferroelectric capacitor that is caused by the reaction.

The Office Action acknowledges that the Cuchiaro patent fails to teach or suggest, among other things, a third coating provided on side faces of said main wiring layer, please see Sec. 4,

Pg. 3 of the Office Action. The Hayashi patent does not supplement the Cuchiario patent to teach this claim recitation in the claimed combination of elements.

The Hayashi patent teaches a semiconductor device and method of manufacturing the same. The second barrier film 23 does **not** cover side faces of wiring film 26. As shown in Fig. 9 of Hayashi, contact holes 22 extend to upper capacitor electrodes 14, col. 12, lines 41-48. A second barrier film 23 is formed in the bottom of the second contact holes 22, col. 13, lines 19-22 and Fig. 10. A wiring film 26 is formed on top of barrier layer 23. Barrier layer 23 is provided in the bottom of contact holes 22 in order to prevent deteriorating a metallic oxide dielectric film of the capacitor. The barrier layer 23 **does not cover** side surfaces of the wiring layer 26, barrier layer 23 is provided on a bottom surface of wiring layer 26. As shown in Fig. 13, the side surfaces of wiring layer 26 are exposed and in contact with interlayer insulating film 27, see highlighted portions of Exhibit A. None of the side surfaces of wiring layer 26 are covered by barrier layer 23. Barrier layer 23 is provided on the bottom surface of wiring layer 26. The fact that the bottom surface of wiring layer 26 is irregular and undulates into the contact holes does not change the fact that it is still a bottom surface and not a side surface. None of the side surfaces of wiring layer 26 are covered by barrier layer 23. Thus, there is no teaching or suggestion in the Hayashi patent of a third coating covering side faces of said main wiring layer as recited in independent claim 1. Therefore, the Office Action fails to establish a *prima facie* case of obviousness because the cited combination of the Cuchiario patent and the Hayasi patent, taken alone or in combination, does not teach or suggest all of the features of independent claim 1. Accordingly, independent claim 1 is allowable.

Claims 2-5 and 7-14 depend from claim 1 and are allowable as being dependent from an allowable claim.

VIII.1 Claim 15.

VIII.1.A Claims 15 is patentable over the three-way combination of the Cuchiario patent, the Hayashi patent, and the Bailey patent.

Claim 15 depends from independent claim 1. Independent claim 1 recites a wiring layer structure comprising a main wiring layer and a coating layer. The coating layer comprises a first coating part, a second coating part and a third coating part covering the side faces of the main wiring layer. Referring to Figure 1, for example, a wiring layer structure connected to a first electrode of a ferroelectric capacitor has first and second electrodes. The wiring layer structure includes a main wiring layer 30 that includes a first material and a coating layer 60. The coating layer 60 includes a first coating part 20 provided between the main wiring layer and the first electrode, a second coating part 50 provided on the top surface of the main wiring layer, and a third coating part 40 covering side faces of the main wiring layer. The first material reacts with a substance to produce a reducing agent. The substance is infiltrated from the outside to the main wiring layer, and the coating layer is conductive and includes a second material for preventing the infiltration of the substance into the main wiring layer 30. Claim 15 additionally recites that the reducing agent is either a hydrogen radical (H^*) or hydrogen (H_2).

In asserting this ground of rejection, the Office Action asserts that Cuchiario teaches a main wiring layer 134 including a first material and a coating layer including a first coating part

126 provided between the main wiring layer and a first electrode 124. The Office Action further asserts that the coating layer (as taught by the Cuchiaro patent) is conductive and comprises a second material for preventing the infiltration of a substance into the main wiring layer. See, the Cuchiaro patent, col. 5, lines 14-32. The Office Action acknowledges that the Cuchiaro patent fails to teach or suggest a second coating part (of the coating layer) provided on the top surface of the main wiring layer, a third coating part (of the coating layer) provided on the side faces of the main wiring layer, and that the reducing agent is either a hydrogen radical (H^*) or hydrogen (H_2).

To overcome these deficiencies, the Office Action, referring to Figure 13, asserts that the Hayashi patent teaches a coating part on the sides of the wiring layer and that it would have been obvious to one having ordinary skill in the art to modify the semiconductor device of the Cuchiaro patent to include a coating layer on the sides of the wiring layer because doing so aids in providing a reliable connection without deterioration. Further, the Office Action asserts that the Bailey patent teaches hydrogen as a reducing agent and that it would have also been obvious to modify the semiconductor device of the Cuchiaro patent to include hydrogen as a reducing agent as disclosed in the Bailey patent. Applicants respectfully traverse this rejection

First, because claim 15 depends directly from claim 1, claim 15 is allowable for at least similar reasons as discussed above with respect to claim 1.

Second, the Bailey fails to overcome the deficiencies of the Cuchiaro patent and the Hayashi patent. Specifically, Bailey does not supplement the Cuchiaro patent or the Hayashi patent to teach or suggest of a third coating covering side faces of said main wiring layer. The Bailey patent instead teaches hydrogen barrier encapsulation techniques. For example, in Fig.

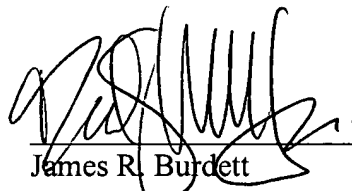
10B, a ferroelectric capacitor 1172 including an upper electrode 1182 is illustrated. A metal wiring layer 1192 is provided over the capacitor 1172. A hydrogen barrier material 1190 covers the ferroelectric capacitor elements, an inner surface of a contact hole, and a portion of a bottom of metal layer 1192, see Fig. 10B and col. 13, lns. 1-21. However, the hydrogen barrier material does not cover side surfaces of wiring layer 1192. The side surfaces of wiring layer 1192 are in contact with an interlayer insulating film. Thus, there is no teaching or suggestion in the Bailey patent of a third coating covering side faces of said main wiring layer as recited in independent claim 1. Therefore, for at least a second reason, claim 15 is allowable over the three-way combination of the Cuchiario patent, the Hayashi patent, and the Bailey patent.

In view of the foregoing, it is submitted that the rejection of claims 1-5, and 7-15 should not be sustained, and a decision to that effect is respectfully requested.

A check in the amount of \$440.00 is enclosed for the submission of this Appeal Brief and a one-month extension of time, which is hereby petitioned for under 37 C.F.R. § 1.136(a). If any additional fee is due, the Commissioner is hereby authorized to charge and/or credit any fees to Deposit Account No. 22-0261.

Respectfully submitted,

Date: 8/30/04



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IX. APPENDIX

1. (Previously Presented) A wiring layer structure connected to a first electrode of a ferroelectric capacitor having first and second electrodes, comprising:
 - a main wiring layer including a first material; and
 - a coating layer including a first coating part provided between said main wiring layer and said first electrode, a second coating part provided on the top surface of said main wiring layer, and a third coating part covering side faces of said main wiring layer;wherein said first material reacts with a substance to produce a reducing agent, said substance being infiltrated from the outside to this main wiring layer, and said coating layer is conductive and comprises a second material for preventing the infiltration of said substance into said main wiring layer.
2. (Original) The wiring layer structure according to Claim 1, wherein said first material is aluminum (Al).
3. (Original) The wiring layer structure according to Claim 1, wherein said second material is titanium nitride (TiN).
4. (Original) The wiring layer structure according to Claim 1, wherein said second material is titanium (Ti).
5. (Original) The wiring layer structure according to Claim 1, wherein said second material is titanium nitride (TiN) and titanium (Ti).
6. (Canceled)
7. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first, second, and third coating parts are titanium nitride (TiN) films.

8. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first and third coating parts are titanium nitride (TiN) films, and said second coating part is a built-up film composed of a titanium (Ti) film and a titanium nitride (TiN) film.
9. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first coating part is a titanium nitride (TiN) film, and wherein said second and third coating parts are built-up films composed of a titanium (Ti) film and a titanium nitride (TiN) film.
10. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first coating part is a titanium nitride (TiN) sputtering film, and said second and third coating parts are TiN-CVD films.
11. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first and second coating parts are TiN-sputtering films, and said third coating part is a TiN-CVD film.
12. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first coating part is a TiN-sputtering film, said second coating part is a built-up film composed of a Ti-sputtering film and a TiN-sputtering film, and said third coating part is a TiN-CVD film.
13. (Previously Presented) The wiring layer structure according to Claim 1, wherein said first coating part is a TiN-sputtering film, said second coating part is a built-up film formed from a Ti-sputtering film and a TiN-sputtering film, and said third coating part is a built-up film formed from a Ti-CVD film and a TiN-CVD film.
14. (Original) The wiring layer structure according to Claim 1, wherein said substance infiltrating from the outside is either water (H₂O) or hydrogen (H₂).

15. (Original) The wiring layer structure according to Claim 1, wherein said reducing agent is either a hydrogen radical (H^*) or hydrogen (H_2).

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